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PENSOFT

# Biodiversity of Sematophyllaceae s. str. in northeastern Brazil

Milena Evangelista-dos-Santos[1*], Emilia de B. Valente[2]

**1** Programa de Pós-Graduação em Botânica, Herbário da UEFS, Universidade Estadual de Feira de Santana, Feira de Santana, BA, Brazil • milenaevangelista16@gmail.com https://orcid.org/0000-0003-0816-2832

**2** Departamento de Ciências Biológicas, Universidade Estadual de Feira de Santana, Feira de Santana, BA, Brazil • ebvalente@gmail.com https://orcid.org/0000-0002-9801-2370

* Corresponding author

**Abstract**

In this study, we list 25 moss species belonging to Sematophyllaceae s. str. Six species are reported for the first time from some of the states in the Northeast Region of Brazil. *Sematophyllum succedaneum* (Hook.f. & Wilson) Mitt. stands out for being found for the first time in this region. The Atlantic Forest is the phytogeographic domain with the greatest number of Sematophyllaceae species, which are either exclusive to this domain or shared with the Caatinga and/or Cerrado. Our study expands on the previous knowledge of these species and provides a foundation for further studies.

**Keywords**

Atlantic Forest, Caatinga, Cerrado, Hypnales, pleurocarpous mosses

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## Introduction

The Northeast Region of Brazil is the third largest region and, has of the largest number of bryophyte species, with an estimated 689 species (Costa and Peralta 2015). This region presents four phytogeographic domains: Caatinga, Cerrado, Amazon Forest (in Maranhão), and Atlantic Forest. According to Drumond et al. (2000), the Caatinga is the largest domain occupying the central, northeastern, and southern area of the Northeast Region of Brazil. The Cerrado occupies the western and southeastern portions, whereas the Atlantic Forest, with its area drastically reduced, lies in the easternmost portion of the Northeast region. Although the Caatinga covers the largest territory, this domain has the lowest species diversity of bryophytes (Costa and Peralta 2015). The predominant ombrophilous forest in the Atlantic region is characterized by a high diversity (Costa and Peralta 2015).

Sematophyllaceae is a large moss family with approximately 49 species in Brazil (Câmara and Carvalho-Silva 2020). Descriptions of Sematophyllaceae species from the Northeast Region are found in the publications by Yano et al. (2009), Varão et al. (2011), Oliveira et al. (2018), Evangelista-dos-Santos et al. (2021), Evangelista-dos-Santos and Almeida (2020), and Souza and Oliveira (2019). Although there are existing published studies on Sematophyllaceae, additional investigations of herbarium collections are required to provide invaluable information.

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The five herbaria with the most specimens collected in the Northeast Region are ALCB, HABIT, HUEFS, UB, and UFB (SpeciesLink 2021). Approximately 126 Sematophyllaceae specimens were found on the SpeciesLink website without identifications to species. Here, we provide a list of all Sematophyllaceae s. str. species occurring in the Northeast Region of Brazil, with taxonomic comments, photographs, ecological information, and geographic and altitudinal distribution.

## Study Area

The Northeast Region of Brazil is located in the Southern Hemisphere tropics (Fig. 1). In the north and east is borders the Atlantic Ocean. Rainfall is between 300 and 2220 mm per year, and the average temperature is between 20 and 40° C (Queiroz et al. 2018). The Northeast Region has a semi-arid climate (Araújo and Martins 1998). The region has the following physiognomies: Savana-estépica, Caatinga do Sertão, arid region with vegetational disjunctions, dense ombrophilous forest, ombrophilous open forest, seasonal semi-deciduous forest, seasonal deciduous forest, and savanna (IBGE 2012).

## Methods

To obtain a preliminary list of the Sematophyllaceae s. str. species in the Northeast Region, we compiled data from published sources (i.e., Yano 1981, 1989, 1994, 2011; Costa et al. 2011; Varão et al. 2011; Oliveira et al. 2018; Evangelista-dos-Santos et al. 2019; Souza and Oliveira 2019). In addition, we consulted the online platforms SpeciesLink (https://specieslink.net/) and Flora e Funga do Brasil 2020 (http://floradobrasil.jbrj.gov.br). For identification of Sematophyllaceae s. str. species, specialized literature was consulted (i.e., Florschutz 1964; Sharp et al. 1994; Buck 1994, 1998; Ramsay et al. 2004; Câmara et al. 2016), and type materials from NY, NHM, and PACA herbaria were requested on loan.

We undertook collection excursions in areas where fewer or dubious records existed (i.e., Serra da Jibóia, BA; Barra do Vento, BA; and Serra da Bela Vista, SE). Between 2019 and 2022, 212 samples were collected following the methodology proposed by Yano (1984). The collected material is deposited in HUEFS and ASE. Specimens were requested from the Alexandre Leal Costa (ALCB) and Anchieta (PACA) herbaria and analyzed in HUEFS. The specimens housed in the herbaria ASE, HABIT, HUESPI, HUNEB, UB, and UFP were observed during visits in 2019 and 2021. The taxonomic classification used here follows Carvalho-Silva et al. (2017) and Deshmukh et al. (2021).

The species are classified according to the substrate they were colonizing (Robins 1952; Bates 2009). The Brazilian phytogeographic domains follow the classification proposed by Fiaschi and Pirani (2009). Of the 25 species included in the list of species, we selected 13 to be described and illustrated, as these species are newly reported from Northeast Region or with is little information in the literature on them.

## Results

Twenty-five species belonging to the family Sematophyllaceae s. str. (Table 1) are known form the Northeast Region of Brazil. Twenty-three species occur in the Atlantic Forest, of which 12 are exclusive to that domain, and 11 are shared with the Cerrado and Caatinga

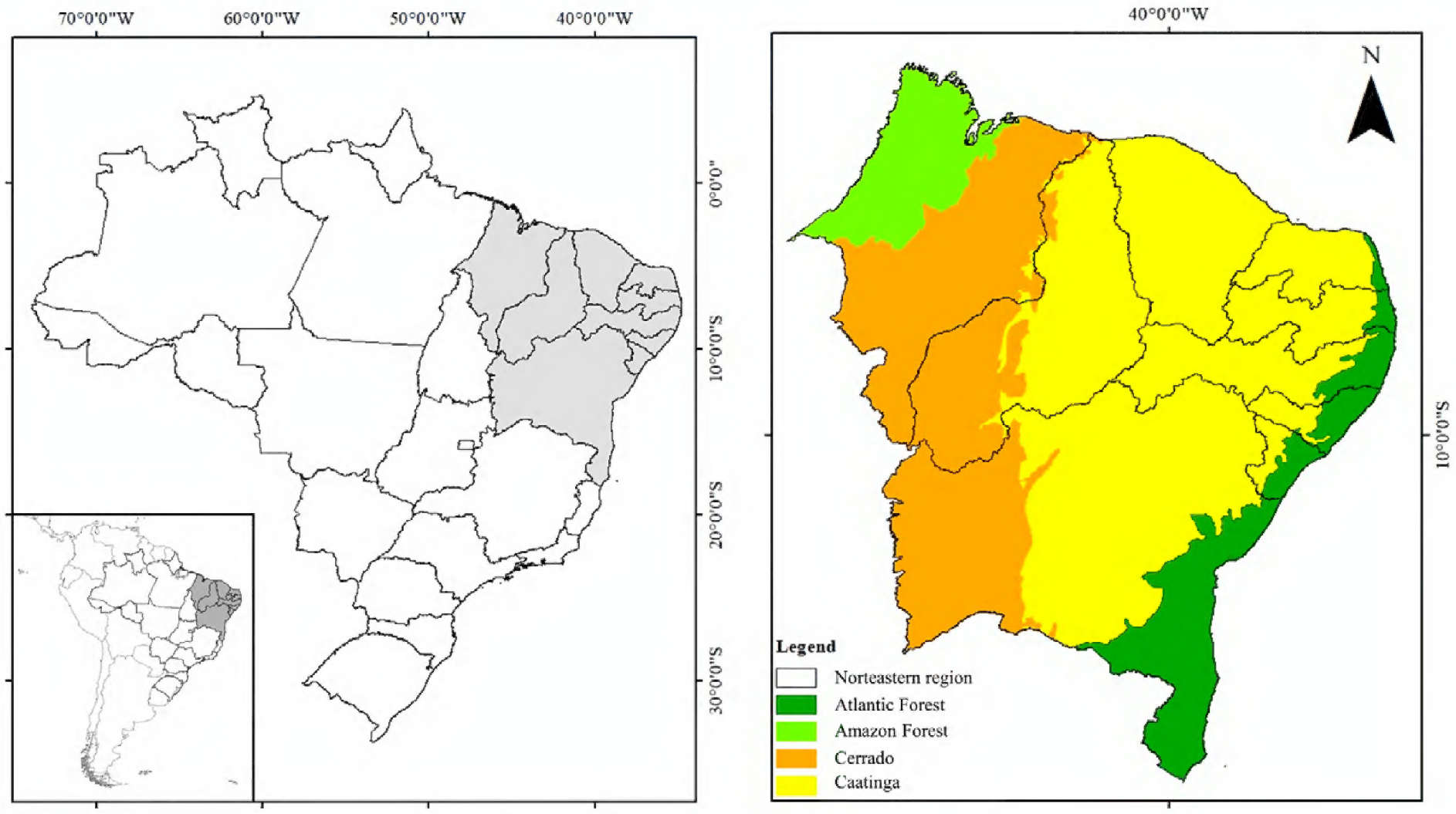


**Figure 1.** Map showing the study area (northeastern Brazil) and its phytogeographic domains.

**Table 1.** Check list of Sematophyllaceae s. str. species in the Northeast Region of Brazil. Phytogeographic domain: CA = Caatinga, CE = Cerrado, AF = Atlantic Forest. Briocenose: Co = Corticolous, Ep = Epimicont, Ex = Epixilous, Ru = Rupiculous, Te = Terriculous, Tm = Termiticola. Distribution in northeastern Brazilian state: AL = Alagoas, BA = Bahia, CE = Ceará, MA = Maranhão, PE = Pernambuco, PI = Piauí and SE = Sergipe. * New records.

| Species | Phytogeografic domain | Briocenose | Elevation | Distribution in Northeastern Brazil by state |
|---|---|---|---|---|
| *Acroporium pungens* (Hedw.) Broth. | AF, CA | Co | 93–800 | BA, CE |
| *Aptychopsis estrellae* (Müll.Hal) P.E.A.S.Câmara, Carv.-Silva & W.R.Buck | AF | Co, Ex | 800–1200 | AL, BA, PE |
| *Aptychopsis pungifolia* (Hampe.) Broth. | AF | Co, Ex | 392–800 | BA, PE |
| *Aptychopsis pyrrhophylla* (Müll.Hal.) Wijk & Margad. | AF | Co, Ru | 1500–1900 | BA |
| *Aptychopsis subpungifolia* (Broth.) Broth. | AF | Co, Ex | 800–1000 | BA |
| *Aptychopsis tequendamensis* (Hampe) P.E.A.S.Câmara, Carv.-Silva & W.R.Buck | AF | Co, Ex | 800 | BA |
| *Brittonodoxa lithophila* (Hornsch.) W.R.Buck, P.E.A.S. Câmara & Carv.-Silva | AF | Co | 500 | BA |
| *Brittonodoxa subpinnata* (Brid.) W.R.Buck, P.E.A.S.Câmara & Carv.-Silva | AF, CA, CE | Co, Ex, Ru, Te | 50–1200 | AL, BA, CE, MA, PE, PI, SE |
| *Colobodontium vulpinum* (Mont.) S.P.Churchill & W.R. Buck | AF, CE | Ru | 1289 | BA |
| *Donnellia commutata* (Müll.Hal.) W.R.Buck | AF, CA, CE | Co, Ex, Ru | 50–1200 | AL*, BA, CE, MA*, PE, SE |
| *Donnellia lageniformis* (Müll.Hal.) W.R.Buck | CA | Ex | | BA |
| *Jirivanaea caespitosa* (Hedw.) U.B.Deshmukh & Rathor | AF, CA | Co, Ru | 1289–1734 | BA |
| *Jirivanaea cuspidifera* (Mitt.) U.B.Deshmukh & Rathor | AF, CA | Co, Ex, Ru | 500–924 | BA, CE*, MA |
| *Jirivanaea galipensis* (Müll. Hal.) U.B.Deshmukh & Rathor | AF, CA, CE | Co, Ep, Ex, Ru, Te, Tm | 92–1690 | BA, CE, MA, PE, PI, SE* |
| *Meiothecium boryanum* (Müll.Hal) Mitt. | AF | Co | 50–383 | BA |
| *Sematophyllum beyrichii* (Hornsch.) Broth. | AF, CA, CE | Co, Ex, Ru, Te | 70–1734 | AL, BA, CE, MA, PE, SE* |
| *Sematophyllum succedaneum* (Hook.f. & Wilson) Mitt. | AF | Co | 800 | BA* |
| *Sematophyllum swartzii* (Schw⊠gr.) W.H.Welch & H.A.Crum | AF, CA | Ex, Ru | 500–1200 | BA, PE* |
| *Trichosteleum brachydictyon* (Besch.) A.Jaeger | AF | Ex | | BA |
| *Trichosteleum glaucinum* (Besch.) A.Jaeger | AF | Co | 583 | BA |
| *Trichosteleum glaziovii* W.R.Buck | AF, CA | Ru | | BA |
| *Trichosteleum lonchophyllum* (Mont.) Carv.-Silva, P.E.A.S. Câmara & W.R.Buck | AF, CE | Co, Ru, Te | | BA |
| *Trichosteleum papillosum* (Hornsch.) A.Jaeger | AF, CA | Ex | 50–200 | BA, PE, SE |
| *Trichosteleum sentosum* (Sull.) A.Jaeger | AF | Co, Te | 92–383 | BA |
| *Trichosteleum subdemissum* (Besch.) A.Jaeger | CA, CE | Co, Ex, Ru, Te | | BA, MA, PI |

phytogeographic domains. Only *Donnellia lageniformis* (Müll.Hal.) W.R. Buck was found exclusively in campo rupestre in the Caatinga domain, growing on decaying wood. *Sematophyllum succedaneum* (Hook.f. & Wilson) Mitt. is newly recorded from the Northeast Region, and the geographic distributions of five other species are expanded: *Donnellia commutata* (Müll.Hal.) W.R.Buck, *Jirivanaea cuspidifera* (Mitt.) U.B.Deshmukh & Rathor, *J. galipensis* (Müll. Hal.) U.B.Deshmukh & Rathor, *Sematophyllum beyrichii* (Hornsch.) Broth., and *S. swartzii* (Schwägr.) W.H.Welch & H.A.Crum. The Brazilian states with the most species are Bahia (25 spp.), Pernambuco (8 spp.), and Maranhão and Ceará (each with 6 spp.). Altitudinal variation ranged between 93 and 1900 m. The diversity of substrates was great, with species growing on tree trunks, decaying logs, rocks, soil, fungi, and termite mounds. The substrate most colonized by Sematophyllaceae s. str. species was logs and decaying wood.

### *Aptychopsis estrellae* (Müll.Hal) P.E.A.S.Câmara, Carv.-Silva & W.R.Buck

Figure 2A–C

**Material examined.** BRAZIL – **Alagoas** • Murici, Estação Ecológica de Murici; 09°22′46″S, 035°50′28″W; 02.XII.2004; K.C. Pôrto leg.; UFP 48852 – **Bahia** • Miguel Calmon, Parque Estadual das Sete Passagens; 11°38′14″S, 040°52′25″W; 1200 m alt.; 11.X.2007; J. Ballejos 1982; ALCB 79378 • Santa Teresinha, Serra da Jiboia; 12°44′55″S, 039°47′55″W; 800 m alt.; 17.IX.2015; S.B.V. Bôas-Bastos 2734; ALCB 119927 – **Pernambuco** • Caruaru, Mata dos Altinhos, Brejo dos Cavalos; 08°28′33″S, 035°17′11″W; 25.XIII.1987; K.C. Pôrto 2443; UFP 20827 • São Vicente Férrer, Serra das Mascarenhas; 07°47′45″S, 035°35′14″W; 23.III.2010; M.P.P. Silva 279; UFP 72135.

**Identification.** Leaves lanceolate to lanceolate-triangular, concave, rarely plane, apex gradually acuminate, margin subentire; cells linear, flexuose, thick-walled, smooth, porose at base; alar cells curved or not to insertion, enlarged, inflated, oblong; supra-alar cells quadratic, 1–2 rows. Capsules cylindric; exostome teeth triangular, bordered or not, cross-striolate below, trabeculate at back; endostome with a medium-high basal membrane, segments papillose, perforate, cilia single sometimes rudimentary.

### *Aptychopsis pyrrhophylla* (Müll.Hal.) Wijk & Margad.

Figure 2D–F

**Material examined.** BRAZIL – **Bahia** • Abaíra, Catolés, Serra do Barbado, Mata da Forquilha; 13°19′47″S, 041°53′12″W; 1655 m alt.; 05. IX.2008; C. Bastos 5166; ALCB 84217 • Rio de Contas, Pico das Almas; 13°57′59″S, 041°51′14″W; 1600 m alt.; 27.XI.1998; R.M. Harley 26634; HUEFS 28246.

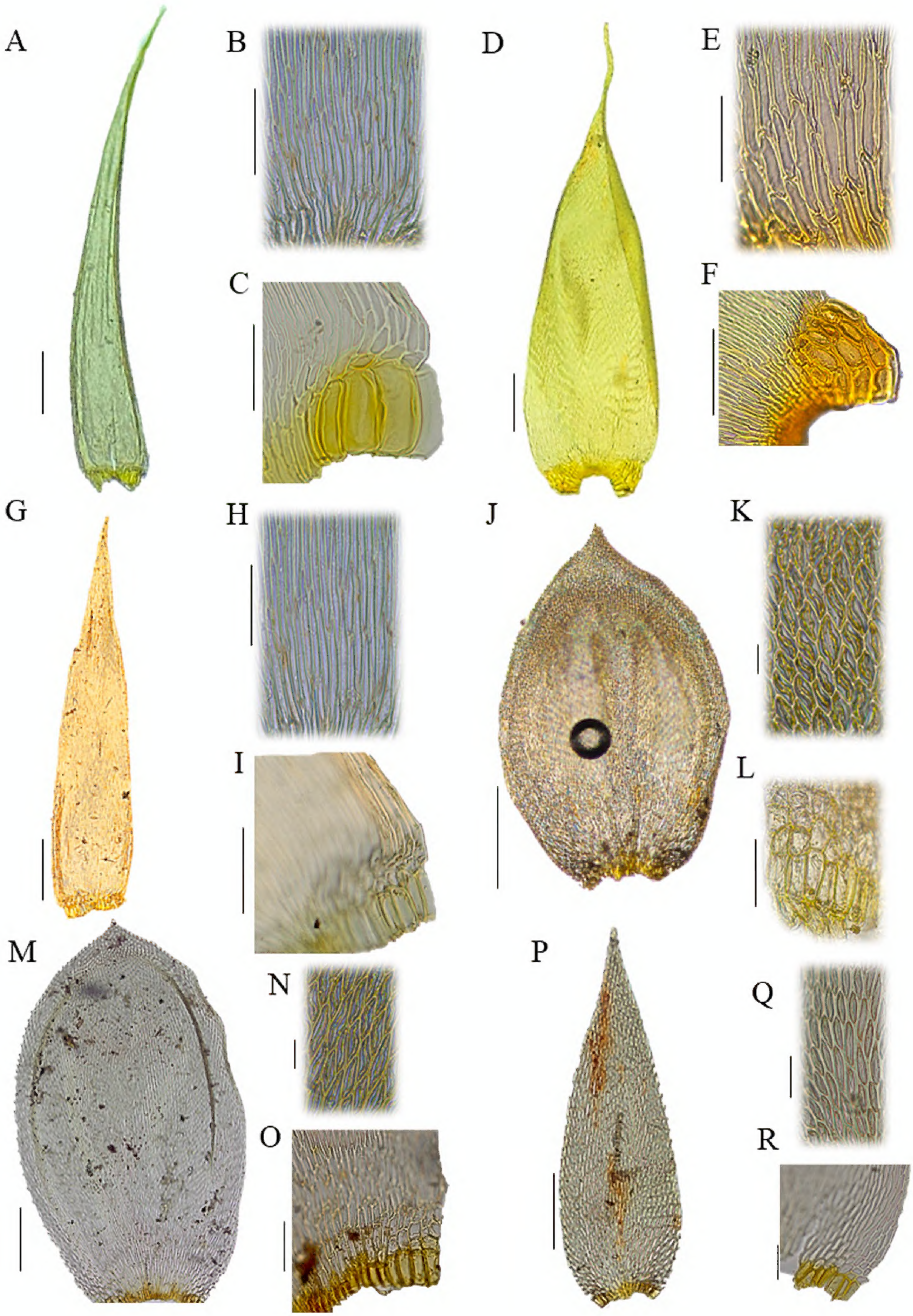


**Figure 2.** Sematophyllaceae s. str. species in the Northeast Region of Brazil. **A–C.** *Aptychopsis estrellae*. **D–F.** *Aptychopsis pyrrhophylla*. **G–I.** *Aptychopsis tequendamensis*. **J–L.** *Brittonodoxa lithophila*. **M–O**. *Colobodontium vulpinum*. **P–R.** *Donnellia commutata*. Scale bars: A, D, G, J, M, P = 200 µm; B, C, E, F, H, I, L, O, R = 50 µm; K, N, Q = 20 µm.

**Identification.** Leaves oblong-lanceolate, concave or plane, apex long-acuminate, margins entire, revolute or not; cells linear-flexuose, thick-walled, smooth, porose at base; alar cells curved to the insertion, enlarged, inflated, oblong; supra-alar cells quadrate to subrectangular, 3–4 rows. Capsule not observed.

***Aptychopsis tequendamensis* (Hampe) P.E.A.S.Câmara, Carv.-Silva & W.R.Buck**

Figure 2G–I

**Material examined.** BRAZIL – **Bahia** • Eunápolis, Estação Ecológica Veracruz, divisa com Imbiriçu; 16°36′06″S, 039°16′26″W; 09.IX.1999; C. Bastos & S.B.V. Bôas-Bastos 1727; ALCB 41679 • Santa Teresinha, Serra da Jiboia; 12°55′55″S, 039°47′55″W; 800 m alt.; 12.III.2002; C. Bastos & S.B.V. Bôas-Bastos 3155; ALCB 51322.

**Identification.** Leaves lanceolate to lanceolate-triangular, plane, apex long-acuminate, margins mostly entire; cells linear-flexuose, short linear at apices, thick-walled, smooth, porose at base; alar cells rarely incurved to insertion, enlarged, rectangular to short-rectangular; supra-alar cells quadrate to rectangular, 1 row. Capsules ovoid to cylindric; exostome teeth triangular, bordered, cross-striolate below, trabeculate at back; endostome with a high basal membrane, segments finely papillose, perforate, cilia single.

***Brittonodoxa lithophila* (Hornsch.) W.R.Buck, P.E.A.S.Câmara & Carv.-Silva**

Figure 2J–L

**Material examined.** BRAZIL – **Bahia** • Nova Esperança, Estação Ecológica Wenceslau Guimarães, Trilha Água Vermelha; 13°35′43″ S, 039°43′10″ W; 550 m alt.; 04.XII.2017; C. Bastos 6147; ALCB 13044.

**Identification.** Leaves orbicular to ovate, concave, rarely plane, apex mucrunate or obtuse, margin subentire; cells rhomboidal, thick-walled, smooth, not porose at base; alar cells not curved to insertion, inflated or not, oblong to short-rectangular; supra-alar cells quadratic to subrectangular, 2–4 rows. Capsule cylindric; exostome teeth triangular, bordered, cross-striolate below, trabeculate at back; endostome with a high basal membrane, segments papillose, perforate, cilia single.

***Colobodontium vulpinum* (Mont.) S.P.Churchill & W.R.Buck**

Figure 2M–O

**Material examined.** BRAZIL – **Bahia** • Piatã, Cachoeira do Patrício; 13°08′35″ S 041°55′46″ W; 1289 m alt.; 04.VI.2007; E.B. Valente 622; HUEFS 153867.

**Identification.** Leaves oval, ovate or semi-orbiculate, concave or plane, apex acute or obtuse, margin subentire; cells rhomboidal to rhombic, thick-walled, smooth, not porose at base; alar cells not curvate to insertion, inflated or not, oblong; supra-alar cells quadratic, 2–4 rows. Capsule cylindric; exostome teeth triangular, not bordered, cross-striolate below, trabeculate at base papillose above; endostome with segments filiform or rudimentary, cilia absent.

***Donnellia commutata* (Müll.Hal.) W.R.Buck**

Figure 2P–R

**Material examined.** BRAZIL – **Alagoas** • Murici, Estação Ecológica de Murici; 09°22′46″S, 035°50′28″W; 02.XII.2004; K.C. Pôrto leg.; UFP 48981 – **Bahia** • Boa Nova, Parque Nacional de Boa Nova, Recanto dos Pássaros; 14°39′20″S, 040°14′46″W; 20.I.2010; A.M. Souza 590; HUEFS 204888 • Igrapiúna, Reserva Ecológica da Michelin; 13°47′19″S, 039°11′51″W; 04.IV.2010; H.C. Oliveira 1737; ALCB 112639 • Itaberaba, Serra do Orobó; 12°35′13″S, 040°46′27″W; 752 m alt.; 10.X.2019; C.J.P. Bastos 5580; ALCB 119569 • Miguel Calmon, Parque Estadual das Sete Passagens; 11°38′14″S, 040°52′25″W; 1200 m alt.; 19.II.2007; J. Ballejos 1214; ALCB 77318 • Morro do Chapéu, Mata do Capão do Pinho; 929 m alt.; 17.VI.2008; E.B. Valente 1196; HUEFS 154441 • Santa Teresinha, Serra da Jiboia; 12°55′55″S, 039°47′55″W; 800 m alt.; 24.IX.2004; E.B. Valente 402; HUEFS 97274 – **Ceará** • Crato, Chapada do Araripe; 07°38′72″S, 040°21′70″W; 920 m alt.; 19.III.1983; S. Prazeres & K.C. Pôrto leg.; UFP 6069 – **Maranhão** • Carolina, RPPN Mansinha; 07°10′49″S, 047°41′21″W; 13.VII.2016; R.R.O. 493; HABIT 3187 – **Pernambuco** • Timbaúba, Engenho, Água Azul; 17.VII.1992; S.R. Germano leg; UFP 8683.

**Identification.** Leaves lanceolate, concave or plane, apex acuminate, margin entire; cells rhomboidal to long-rhomboidal, thick-walled, smooth, not porose at base; alar cells not curved to insertion, oblong; supra-alar cells quadratic, 2–4 rows. Capsules cylindric; exostome teeth triangular, bone-white, not bordered, with prominent cross walls, slightly trabeculate at back; endostome reduced with a very low basal membrane, sometimes absent, cilia absent.

***Sematophyllum beyrichii* (Hornsch.) Broth.**

Figure 3A–C

**Material examined.** BRAZIL – **Alagoas** • Murici, Estação Ecológica de Murici; 09°22′46″S, 035°50′38″W; 21.XII.2004; K.C. Pôrto leg.; UFP 48977 – **Bahia** • Abaíra, Catolés, Serra do Barbado, Mata do Cigano; 13°19′47″S, 041°53′12″W; 1734 m alt.; 06.IX.2008; C. Bastos 5246; ALCB 84328 • Boa Nova, Parque Nacional de Boa Nova, Recanto dos Pássaros; 14°39′20″S, 040°14′56″W; 27.VI.2013; A.M. Souza 653; HUEFS 204959 • Eunápolis, Estação Ecológica Veracruz, trilha pau-brasil; 16°36′60″S, 039°16′60″W; 08.IX.1999; C. Bastos & S.B.V. Bôas-Bastos 1639; ALCB 45051 • Igrapiúna, Reserva Ecológica da Michelin; 13°47′19″S, 039°11′51″W; 383 m alt.; 03.IV.2010; H.C. Oliveira 1679; ALCB 112604 • Itaberaba, Serra do Orobó; 12°35′13″S, 040°46′67″W; 752 m alt.; 18.I.2015; R. Freitas 120; ALCB 119497 • Miguel Calmon, Parque Estadual das Sete Passagens; 11°38′14″S, 040°52′25″W; 1200 m alt.; 19.II.2007; J. Ballejos 1256; HUEFS 187538 • Santa

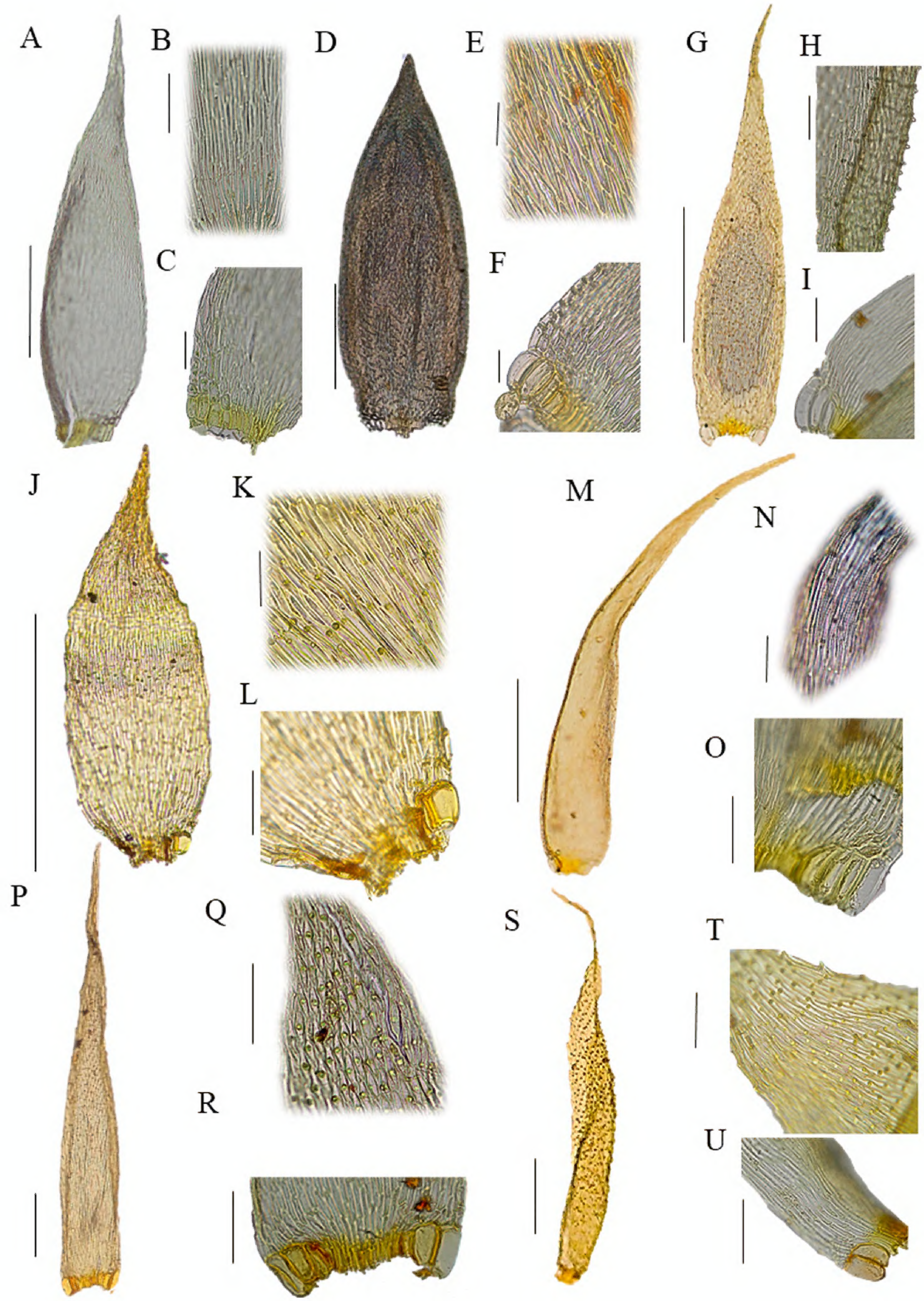


**Figure 3.** Sematophyllaceae s. str. species in the Northeast Region of Brazil. **A–C.** *Sematophyllum beyrichii*. **D–F.** *Sematophyllum succedaneum*. **G–I.** *Trichosteleum brachydictyon*. **J–L.** *Trichosteleum glaucinum*. **M–O**. *Trichosteleum glaziovii*. **P–R.** *Trichosteleum papillosum*. **S–U.** *Trichosteleum sentosum*. Scale bars: A, D, G, J, M, P, S = 200 µm; B, C, H, I, N, O, Q, R, T, U = 50 µm; F, K, L = 20 µm; E = 10 µm.

Teresinha, Serra da Jiboia; 12°55′55″S, 039°47′55″W; 800 m alt.; 03.IV.1999; E. Mello 2670; HUEFS 36594 – **Ceará** • Ubajara, Serra da Ibiapaba, São Luís; 03°58′45″S, 041°09′00″W; 924 m alt.; 24.VIII.2010; C. Bastos 5360; ALCB 97126 – **Maranhão** • Mirador; 30.VI.2008; E.S. Brito & G.M. Conceição leg.; HABIT 574 – **Pernambuco** • Reserva Ecológica de Garjaú, Mata do encruzamento; 06.VI.2000; S.R. Germano leg.; UFP 32934.

**Identification.** Leaves lanceolate or oblong-lanceolate, convave, rarely plane, apex acuminate; cells linear, flexuose, thick-walled, smooth, not porose at base; alar cells not curved to insertion, inflated, oblong; supra-alar cells quadratic, 1–2 rows. Capsules cylindric; exostome teeth triangular, bordered, cross-striolate below, trabeculate at back; endostome with a high basal membrane, segments papillose, perforate or not, cilia none or rudimentary.

***Sematophyllum succedaneum* (Hook.f. & Wilson) Mitt.**

Figure 3D–F

**Material examined.** BRAZIL – **Bahia** • Santa Teresinha, Serra da Jiboia; 12°55′55″S, 039°47′55″W; 800 m alt.; 13.IX.1997; E. Melo 2217; HUEFS 29954.

**Identification.** Leaves oblong-lanceolate, plane or concave, apex acuminate, margin entire to subentire; cells rhomboidal, flexuose, thick-walled, smooth, not porose at base; alar cells not curved to insertion, inflated or not, oblong; supra-alar cells quadratic, 1 row. Capsules cylindric; exostome teeth triangular, not bordered, cross-striolate below, trabeculate at back; endostome with a high basal membrane, segments papillose, perforate, cilia single.

***Trichosteleum brachydictyon* (Besch.) A.Jaeger**

Figure 3G–I

**Material examined.** BRAZIL – **Bahia** • Eunápolis, Estação Ecológica Veracruz, fazenda Malacarne; 16°36′00″S, 039°16′00″W; C. Bastos & S.B.V. Bôas-Bastos 2129; ALCB 44918.

**Identification.** Leaves lanceolate or oblong-lanceolate, concave, apex long-acuminate, rarely twisted, margins serrulate; cells linear, flexuose, thick-walled, unipapillose in ½ of leaf, porose at base; alar cells not curved to insertion, enlarged, inflated, oblong; supra-alar cells quadratic, 1–2 rows. Capsules cylindric; exostome teeth triangular, bordered, cross-striolate below, trabeculate at back; endostome with a high basal membrane, segments papillose, perforate, cilia single.

***Trichosteleum glaucinum* (Besch.) A.Jaeger**

Figure 3J–L

**Material examined.** BRAZIL – **Bahia** • Nova Esperança, Estação Ecológica Wenceslau Guimarães, Trilha Água Vermelha; 13°35′43″ S, 039°43′10″ W; 583 m alt.; 29.IX.2017; R.R. Ferminano 102; ALCB 124284.

**Identification.** Leaves lanceolate or oblong-lanceolate, concave or plane, apex short-acuminate, rarely twisted, margins serrulate; cells linear to rhomboidal, think-walled, unipapillose in ¾ of leaf, porose in the insertion; alar cells not curved to insertion, inflated, ovate to oblong; supra-alar cells not differentiated. Capsule not observed.

***Trichosteleum glaziovii* W.R.Buck**

Figure 3M–O

**Material examined.** BRAZIL – **Bahia** • Miguel Calmon, Parque Estadual das Sete Passagens; 11°38′14″S, 040° 52′25″W; 1200 m alt.; 22.IV.2003; C. Bastos & S.B.V. Bôas-Bastos 3699; ALCB 51783.

**Identification.** Leaves falcate, lanceolate, concave, apex acuminate, margins serrulate; cells linear, flexuose, thick-walled, unipapillose, sometimes papillae are inconspicuous, porose at base; alar cells not curved to insertion, inflated, oblong; supra-alar cells quadratic 1 row. Capsule not observed.

***Trichosteleum papillosum* (Hornsch.) A.Jaeger**

Figure 3P–R

**Material examined.** BRAZIL – **Bahia** • Boa Nova, Parque Nacional de Boa Nova, Recanto dos Pássaros; 14° 39′20″S, 040°14′96″W; 27.VI.2013; A.M. Souza 678; HUEFS 204984 • Una, Reserva Ecológica do Mico-Leão; 14°47′00″S, 039°03′17″W; 100 m alt.; 26.IV.1981; B.M. Boom 794; CEPLAC 49719 • Nova Esperança, Estação Ecológica Wenceslau Guimarães, Trilha Água Vermelha; 13°35′43″S, 039°43′10″W; 583 m alt.; 29.IX.2017; L.C. Reis 629; ALCB 96976 – **Pernambuco** • Recife, Mata de Dois Irmãos, perto da Sede do Reservatório; 08°05′38″S, 034°56′26″W; 03.VIII.1998; O. Yano et al. 23412; UB 204790 – **Sergipe** • Itabaiana, Serra de Itabaiana; 10°41′50″ S, 037°25′29″ W; 190 m alt.; 13.I.1981; D. Andrade-Lima 6744; UB 204680.

**Identification.** Leaves lanceolate or oblong-lanceolate, plane or concave, apex acuminate to crispate, margins serrulate; cells fusiform to linear fusiform, thick-walled, unipapillose in ½ of leaf, porose at base; alar cells not curved to insertion, inflated, oblong; supra-alar cells quadrate, 1–2 rows. Capsule not observed.

***Trichosteleum sentosum* (Sull.) A.Jaeger**

Figure 3S–U

**Material examined.** BRAZIL – **Bahia** • Boa Nova, Parque Nacional de Boa Nova, Recanto dos Pássaros; 14°39′20″S, 040°14′16″W; 27.VI.2013; A.M. Souza 608; HUEFS 204907 • Igrapiúna, Reserva Ecológica da Michelin; 13°47′19″S, 039°11′51″W; 383 m alt.; 12.VIII.2006; S.B.V. Bôas-Bastos 2224; ALCB 77065 • Nova Esperança, Estação Ecológica Wenceslau Guimarães, Trilha Água Vermelha; 13°35′43″S, 039°43′10″W; 583 m alt.; 29.VII.2019; R.R. Ferminano; ALCB.

**Identification.** Leaves lanceolate or oblong-lanceolate, concave or plane, apex long-acuminate, flexuose and twisted, margins serrate; cells linear, thick-walled, unipapillose in ¾ of leaf, porose at base; alar cells not curved to insertion, inflated, oblong; supra-alar cells quadrate,

1–2 rows. Capsules cylindric; exostome teeth triangular, bordered, cross-striolate below, trabeculate at back; endostome with a high basal membrane, segments papillose, perforate, cilia single rarely in pairs.

## Discussion

According to Câmara and Carvalho-Silva (2022), Sematophyllaceae s.lat. is represented in the Northeast Region of Brazil by 23 species, five of which currently belong to the family Pylaisiadelphaceae Goffinet & W.R.Buck. Hence, 18 species of Sematophyllaceae s. str. were known from this region (Carvalho-Silva et al. 2017). In Brazil, 38 species of Sematophyllaceae s. str. are recognized (Câmara and Carvalho-Silva 2022), and with 25 species, in the Northeast Region has 65.7% of the total reported for the country. All species were found in the state of Bahia (Evangelista-dos-Santos et al. 2021).

The species reported from the Northeast Region are similar to the other Brazilian regions, especially the South and Southeast Regions, according to the published literature (i.e., Visnadi 2006; Amélio 2019; Faria et al. 2020; Koga and Peralta 2021; Remor et al. 2021). The South and Southeast Regions are predominantly within the Atlantic Forest domain, which has the largest number of species of the family in Brazil, which justifies the similarity (Costa and Peralta 2015).

With our new data from previously unexplored locations and new records from the Caatinga or Cerrado domain, the number species know form the Northeast Region is considerably increased. The occurrence of the relatively larger number of Sematophyllaceae s. str. species found in this region can be explained by the variety of habitats, floristic heterogeneity, and environmental conditions (Giulietti et al. 2005; Moraes et al. 2020). Greater availability of water, which provides ideal microhabitats for bryophytes may also be of importance (Vanderpoorten and Goffinet 2009).

Although cited in the literature, some species have not since been recorded in certain places, such as *Aptychopsis estrellae* cited for the Serra de Itabaiana in Sergipe (Silva and Pôrto 2015), *Jirivanaea caespitosa* (Hedw.) U.B.Deshmukh & Rathor for the Serra do Cariri in Pernambuco (Yano 1981), and *Trichosteleum sentosum* for Pernambuco with no defined location (Costa et al. 2011; Yano 2011). These are likely misidentifications. The specimens originally identified as *A. estrellae* were found to be *Sematophyllum beyrichii*.

*Sematophyllum adnatum* (Michx.) E.Britton is frequently cited for the Northeast Region (Alvarenga et al. 2007; Yano et al. 2009; Costa et al. 2011; Yano 2011; Evangelista-dos-Santos et al. 2019), but it is excluded here, as specimens identified as this species instead belong to *S. beyrichii*. *Donnellia commutata* requires a detailed analysis of the sporophytic characteristics for its identification. In the absence of sporophytes, the gametophytes on leaves resemble some forms of *Brittonodoxa subpinnata* (Evangelista-dos-Santos et al. 2021). *Jirivanaea cuspidifera* (Mitt.) U.B. Deshmukh & Rathor is often confused with *Sematophyllum beyrichii*.

The species analyzed in this study occurr preferentially in the Atlantic Forest, and 10 occur exclusively in this domain (Fig. 1). In contrast, only *Donnellia lageniformis* (Müll.Hal.) W.R.Buck was found exclusively in the Caatinga, in campo rupestre, growing on decaying plant material. The presence of this species is known in the South and Southeast regions of the country, such as riparian forest formations or gallery and mixed ombrophilous forest of the Atlantic region (Câmara and Carvalho-Silva 2022). Its identification was possible thanks to the presence of the sporophyte that made it possible to distinguish between *D. commutata* (Buck 1994; Evangelista-dos-Santos et al. 2021).

According to Gradstein and Pócs (1989) and Frahm (1990), most bryophytes colonize the trunks of living trees, and pH and a rough cortex help in their establishment. Few species grow on only one type of substrate, such as *Acroporium pungens* (Hedw.) Broth. on the bases of living tree trunks, *Colobodontium vulpinum* on rocks, *Trichosteleum papillosum* on decaying plant material, and *Trichosteleum glaziovii* on rocks.

Our results show the importance of analyzing herbarium collections in better understanding species. Many of the new occurrences records come from materials originally identified at the family or genus level. Based on our results we highlight the important contribution of taxonomic study of herbarium collections.

## Authors' Contributions

Conceptualization: MES. Data curation: MES. Formal analysis: MES. Investigation: MES. Methodology: MES. Project administration: MES. Resources: MES. Software: MES. Supervision: EBV. Validation: MES. Visualization: MES. Writing – original draft: MES. Writing – review and editing: MES.

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